# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-169462
(43)Date of publication of application : 14.06.2002

(51)Int.Cl. G09B 21/00
C04B 35/46
H01L 41/09
H01L 41/187
H04R 1/00
H04R 17/00

(21)Application number : 2000-403761
(22)Date of filing : 02.12.2000

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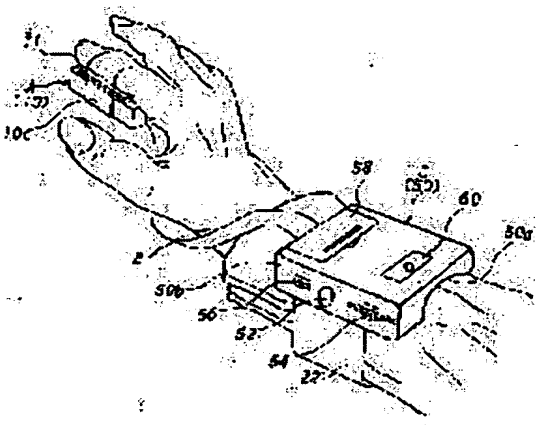
## (54) IMPROVEMENT OF TACTILE SECTION OF HEARING SENSATION ASSISTING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a large amount of displacement and generating power with a low voltage as compared with a known piezoelectric single crystal element and eventually to obtain amplitude of ≥10 times.



SOLUTION: The tactile section which is connected to a data processing section mounted at the wrist of a hearing and language handicapped person is constituted by adopting a piezoelectric single crystal element as a diaphragm disposed in this tactile section in such a manner that the large amount of displacement and power are obtained with the low voltage by the largest electric machine coupling coefficient not possible with the piezoelectric materials and the extremely high piezoelectric constant and acoustic information, such as speech, is subjected to a frequency analysis. The angular tactile pins on the diaphragm are vertically vibrated independently from below by a sweep presentation system, by which the continuous transmission of the exact vibration pattern information to the skin of the fingertip is made possible.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

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CLAIMS

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[Claim(s)]
[Claim 1] It connects with the data-processing section attached in the wrist of a serious acoustic sense and aphasic. And an electromechanical coupling coefficient is very large in the diaphragm formed in; this tactile-sense circles in the tactile-sense section with which a fingertip is equipped. And change as a piezo-electric single crystal component which has a high piezoelectric constant, and frequency decomposition of the; input sound signal is carried out. Amelioration of the tactile-sense section of the acoustic-sense auxiliary device characterized by what each tactile-sense pin on this diaphragm is vibrated independently of the bottom with a sweep presentation method, respectively, and it changes into exact oscillating pattern information, and is transmitted succeeding the skin of a fingertip.
[Claim 2] Amelioration of the tactile-sense section of an acoustic-sense auxiliary device carried out to the publication in this piezo-electric single crystal component at claim 1 which changes as PZT ceramics.
[Claim 3] Amelioration of the tactile-sense section of the acoustic-sense auxiliary device indicated to be zinc niobic acid Pb(Zn1/3Nab 2/3) O3 (PZT) in this PZT ceramics by claims 1 and 2 which change as a solid-solution single crystal PZNT 91/9 with PbTiO3(PT).

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to amelioration of the tactile-sense section of an acoustic-sense auxiliary device. In more detail For serious acoustic sense and aphasic, frequency decomposition of the sound information, such as voice, is carried out. Vibrate a tactile-sense pin independently up and down with a sweep presentation method, and it is related with the tactile-sense section of an acoustic-sense auxiliary device which continues and transmits exact oscillating pattern information to the skin. It will be related with the No. [ 258197 ] amelioration a patent application No. 376868 and the 2000 application for patent in Heisei 11. The piezo-electric single crystal component (electrostrictive ceramics) for which an electromechanical coupling coefficient has a very large and, high piezoelectric constant is prepared in the diaphragm formed in the tactile-sense circles, and it is related with amelioration of the tactile-sense section of an acoustic-sense auxiliary device convenient for the cellular phone whose miniaturization can acquire the big amount of displacement and the big force by the low battery, and is attained.
[0002]
[Description of the Prior Art] To the serious acoustic sense, aphasic, etc., a sound signal is changed into an oscillating pattern according to a piezoelectric effect, and the tactile-sense stimulators (for example, JP,62-275284,A etc.) which show an oscillating stimulus to a fingertip through an oscillating pin are proposed. In such tactile-sense stimulators, on both sides of the electric conduction plate, it unified between up-and-down piezo plates, slitting of plurality was formed from the end side, it considered as two or more piezo bimorph elements, either the piezo plate or the electric conduction plate was used as the common electrode, another side was used as the segment electrode, and the structure which fixed the metal wire of predetermined die length to the point of the piezo bimorph element of a circuit base, respectively is adopted.
[0003] Furthermore, it sets to the already proposed tactile-sense stimulator as shown in drawing 11 . Make the insulating spacer 102 placed between the ends of the guide plate 100 of two sheets, and at intervals of necessary, the insulating spacer 106 of the piezo-electric element 104 which aligned horizontally and which is each two or more sheets from which die length is different is placed between the lower part, and it aligns horizontally at intervals of necessary in it. And it is the tactile-sense section made into the vibrator matrix which bore 100a which drilled the upper limit of each oscillating pin 108 by which each lower limit was put on the end of this spacer 104 in this guide plate 100 is made to penetrate from the bottom, and stimulates the inferior surface of tongue of a fingertip.
[0004]
[Problem(s) to be Solved by the Invention] It was what it cannot but be inadequate to change a sound signal into an exact oscillating pattern since the number of each [ which a configuration becomes inevitably and large, and, as for well-known tactile sense stimulator, the increase of weight and a hearing-impaired person are very inconvenient to always carry, and is driven by each piezo bimorph element ] oscillating pin is restricted, and to output to a fingertip as an oscillating stimulus, also cannot but be that of laboratory level, and is not fit for practical use immediately.
[0005] And the greatest defect in the tactile-sense section of well-known tactile-sense stimulator is that miniaturize this tactile-sense section and the big amount of displacement and the big force are

not generated by the diaphragm by the low battery.
[0006] A piezo-electric single crystal component attracts attention in recent years as a thing which makes a diaphragm generate the big amount of displacement and the big force, and it is used for the probe which is the transceiver device of a medical ultrasonic diagnostic equipment.
[0007] The reason is that the electromechanical coupling coefficient (namely, thing which the square root of the ratio of the energy accumulated during the crystal in the mechanical form over the electric total input defined) showing the conversion efficiency of electrical energy and ultrasonic energy is large, and that the one where a dielectric constant is larger in order to aim at electric adjustment with a transceiver circuit is good like an array probe when one element is small. As an example of such an array probe, zircon lead titanate [chemical formula {Pb(Zr1-xTix) O3 and Henceforth, PZT} electrostrictive ceramics is used until now.
[0008] However, it will not be improved in 20 or so years, but this place of the engine performance of PZT system electrostrictive ceramics depended on an improvement from structure sides, such as formation of many components and two-dimensional-array-izing, is [ the improvement in the engine performance of an ultrasonic probe ] large.
[0009] The relaxer system piezo-electricity single crystal component with the very large electromechanical coupling coefficient it is expected that an extensive improvement of the sensibility which is the fundamentality ability of an ultrasonic probe recently, and a band is is proposed.
[0010] A relaxer (Relaxor) is the generic name of the ferroelectric in which the property (this is called Dielectric relaxation) in which the temperature which shows the maximum of a dielectric constant moves to high temperature with a frequency, and dielectric constant maximum falls further is shown.
[0011] Lead-zinc-niobate Pb(Zn1/3Nb 2/3) O3 (PZN) which J.Kuwata etc. reported in 1982, and PZNT 91/9 which is a solid-solution single crystal with PbTiO3(PT) are one of those by which the relaxer was put in practical use. They clarified the bearing dependency of a piezo-electric property for the first time with this single crystal, and especially the crystal of [001] sides has reported that that electromechanical coupling coefficient k33 is very as high as 92% and piezoelectric-constant d33=1500 pC/N.
[0012] PZT electrostrictive ceramics will be developed for the first time in 1955, and by adding a small amount of additive after that, 33 is improved an electromechanical coupling coefficient k33 and a several d piezoelectric constant, and it has resulted in current. Although it expects that a piezo-electric property improves and inquires 30 years or more before if PZT is used as a single crystal, there is still no example of a success of large-sized single crystal growth. If this contains lead zirconate, in the presentation (= the phase boundary of rhombohedral training and ******) with a big coupling coefficient, it is for being easy to decompose and the single crystal exceeding 2mm angle is not obtained.
[0013] It became clear that the piezo-electric single crystal PZNT 91/9 had the maximum electromechanical coupling coefficient (k33=99%) in an old piezoelectric material. Although there are many configuration elements as compared with PZT, since this single crystal does not contain a zirconium (Zr), a large-sized crystal is comparatively easy for it.
[0014] A PZNT system piezo-electricity single crystal pays a raw material to the solvent (lead oxide in this case) called flux, and is raised recently. As for the raising method, the Bridgman method, the raising method, etc. are enforced from the flux growth from simple nature, and presentation control and mass-production nature.
[0015] It is these Bridgman methods and the raising method, and became raisable [ the big crystal which the crucible which paid especially the raw material is cooled and can cut down the wafer of 40mmphi ]. PZNT91 / 9 single-crystal wafer which starts the piezo-electric single crystal component of this magnitude so that a coupling coefficient may become parallel to the largest (001) field, and has a piezo-electric big property were obtained.
[0016] That the piezo-electric property excellent also in Pb(Mg1/3Nb 2/3) O3-PbTi systems other than PZNT is shown by Shrout It is reported (T. Shroutet al, "Dielectric behavior of singlecrystals near(1-x) Pb(Mg1/3 Nb 2/3) O3-(X) ()). [ PbTi ] O3 morphotropic phase boundary" Ferroelectric Letters12, pp, 63-69 (1990).
[0017] This is shown in Table 1 as a property of various relaxer lead titanate system single crystals

and the PZT system ceramics.

表1 各種リラクサーチタン酸鉛系単結晶およびPZT系セラミックスの特性

| | PZNT91/9単結晶 | PZT系セラミックス |
|---|---|---|
| 電気機械結合係数 kt(%) | 60 | 45－55 |
| 電気機械結合係数k33(%) | 90－94 | 60－80 |
| 圧電定数d33(pC/N) | 1500－2500 | 200－800 |
| 融点(温度) | 1200前後 | 1350前後 |
| 単結晶サイズ | 40mm | ＜1mm |

[0018] Since the tactile-sense section of the data-processing section is miniaturized, making as thin as possible the diaphragm formed in these tactile-sense circles is taken into consideration, but in order to change the inputted speech information into an electrical signal and to transmit to a hearing-impaired person's fingertip as a positive oscillating stimulus, it is being unable to make the thickness not much thin.

[0019]

[Means for Solving the Problem] In the tactile-sense section with which invention concerning this application is connected to the data-processing section attached in the wrist of an acoustic sense and an aphasic serious as mentioned above, and a fingertip is equipped The diaphragm formed in these tactile-sense circles is set to PZNT 91/9 which is a piezo-electric single crystal component. The maximum electromechanical coupling coefficient unprecedented in piezoelectric material (k33=92%), By obtaining a very high piezoelectric constant (d33=1500 pC/N) Acquire the big amount of displacement and the big force by the low battery, and frequency decomposition of the sound information, such as voice, is carried out. The angle tactile-sense pin on this diaphragm is vibrated up and down independently of the bottom with a sweep presentation method, and it considers as the tactile-sense section of an acoustic-sense auxiliary device convenient for the cellular phone which continues and transmits exact oscillating pattern information to the cutaneous sensation of a fingertip.

[0020] In an acoustic-sense auxiliary device convenient for the cellular phone which the 1st summary of this invention carries out frequency decomposition of the sound information, such as voice, and a tactile-sense pin is vibrated independently up and down with a sweep presentation method, and continues and transmits exact oscillating pattern information to the skin of a fingertip Attach the data-processing section in the wrist of a serious acoustic sense and aphasic, and it connects with this data-processing section. And an electromechanical coupling coefficient is very large in the diaphragm formed in the tactile-sense circles with which the fingertip was equipped. And prepare the piezo-electric single crystal component which has a high piezoelectric constant, and it sets to an acoustic-sense auxiliary device convenient for the cellular phone whose miniaturization can acquire the big amount of displacement and the big force by the low battery, and is attained. It is amelioration of the tactile-sense section of the acoustic-sense auxiliary device characterized by acquiring the big amount of displacement and the big force by the low battery, vibrating this each tactile-sense pin on this diaphragm up and down independently of the bottom for an input sound signal to an exact oscillating pattern, respectively, and continuing and transmitting exact oscillating pattern information to this skin.

[0021] The 2nd summary of this invention is amelioration of the tactile-sense section of the acoustic-sense auxiliary device which changes considering a ******** component as PZT ceramics.

[0022] The 3rd summary of this invention is amelioration of the tactile-sense section of the acoustic-sense auxiliary device which uses PZT ceramics as the solid-solution single crystal PZNT 91/9 of zinc niobic acid Pb(Zn1/3Nb 2/3) O3 (PZT) and PbTiO3(PT), and changes.

[0023]

[The mode of implementation of invention] In the tactile-sense section of the acoustic-sense auxiliary device of this invention, the data-processing section is attached in the wrist of a serious acoustic sense and aphasic as above-mentioned. An electromechanical coupling coefficient is very large in the diaphragm formed in the tactile-sense circles with which are connected to this data-

processing section, and a fingertip is equipped. And the piezo-electric single crystal component which has a high piezoelectric constant is prepared, and the big amount of displacement and the big force can be acquired by the low battery. And it is the tactile-sense section of an acoustic-sense auxiliary device convenient for the cellular phone whose miniaturization is attained. This each tactile-sense pin on this diaphragm is vibrated up and down independently of the bottom for an input sound signal to an exact oscillating pattern, respectively. It is amelioration of the tactile-sense section of an acoustic-sense auxiliary device which formed the diaphragm which continues and transmits exact oscillating pattern information to this cutaneous sensation, and has the amplitude of 10 times or more as compared with a well-known piezo-electric single crystal component.

[0024]

[Example] The example of amelioration of the tactile-sense section in the acoustic-sense auxiliary device indicated by the claim 1 publication is explained about a drawing. In drawing 1 -10, the tactile-sense section A of the acoustic-sense auxiliary device concerning this invention is concluded on the fingertip ft inferior surface of tongue of an index finger or the middle finger, and connects the data-processing section C partially attached in a wrist top face in the state of fitting by the flexible cable B.

[0025] Attach band 10c for conclusion to Fingertip ft in the side face of this tactile-sense section A, and always contact the fingertip ft inferior surface of tongue of this index finger and the middle finger, and it prepares in it. The oblong casing 10 which has necessary magnitude The longitudinal direction center line c It considers as the configuration which approaches center lines c and c near the back end R of each areas 10a and 10b formed by carrying out for 2 minutes by c, forms the 1st guidance bolts 12 and 12 symmetrically, and can prepare 14 and 14 symmetrically to center lines c and c near the outside near the front end F. [ volt / 2nd ]

[0026] Each partition 10a of this oblong casing 10, diaphragm 16a of a Uichi Hidari pair contained in 10b, and 16b-- The part which is a little distant from the inside of these 1st guidance bolts 12 and 12 with the center lines c and c, The tactile-sense pin fitting hole 16a1 of a necessary diameter and 16b1 -- are drilled in two trains at intervals of necessary to the part which separated the 2nd volt from the inside of 14 and 14 a little, and they are these each diaphragms 16a and 16b. -- This tactile-sense pin fitting hole 16a1 and 16b1 -- on the top face Outside twist, It is alike from these each 1st guidance bolts 12 and 12, a piezo-electric element 18 and 18 -- are prepared, respectively, and they are these each piezo-electric elements 18 and 18. -- Lead wire 18a and 18b -- An end is connected, respectively and this lead-wire 18a and 18b-- are connected to a necessary electric wire (not shown).

[0027] By each diaphragm 16a and 16b--, the through tubes 16c and 16d of these 2nd guidance bolts 12 and 14 are drilled in the correspondence part of these 1st and 2nd guidance bolts 12 and 14, and penetration of these 1st and 2nd guidance bolts 12 and 14 is enabled at these through tubes 16c and 16d.

[0028] Each diaphragm 16a of a right-and-left pair, and 16b-- as above-mentioned This area 10a, Two or more sheets, for example, 32 sheets, are arranged in the state of a laminating through the insulating spacer 22 and 22 --, respectively in 10b. These diaphragms 16a and 16b -- This tactile-sense pin fitting hole 16a1, 16b1 -- The tactile-sense pin 20 and 20 -- which have the die length which is different inside, respectively are fitted in loosely free [ vertical movement ]. [0029] of each diaphragm of 32 sheets 16a of a laminating condition, and 16b-- which fits in these each 1st guidance bolts 12 and 14 in this through tube 12a and 12a, respectively Tactile-sense pin fitting hole 40a and 40b-- are drilled in the part of each diaphragm 16a of a right-and-left pair, and 16b-- where this tactile-sense pin fitting hole 16a1 and 16b1 -- correspond also at the tactile-sense pin guide plate 40 which kept necessary spacing in these each top diaphragms 16a and 16b of a Uichi Hidari pair, and was prepared in the upper part of this oblong casing 10 at one.

[0030] And diaphragms 16a and 16b of a Uichi Hidari pair contained in each partition 10a of this oblong casing 10, and 10b -- This tactile-sense pin fitting hole 16a1, 16b1 -- Upper limit 20b and 20b-- is fitted in loosely inside, and it is always contacted by the skin under [ of an index finger or the middle finger ] fingertip ft.

[0031] A little larger stopper 20a to the lower part or pars intermedia than the diameter of each of this fitting hole 16a1, It has 20b-- in one. Each diaphragm of 32 sheets 16a of a Uichi Hidari pair [ lower limit ], It has these 64 tactile-sense pins 20, and the die length, width of face and thickness of

20 -- which contact each upper limit from this tactile-sense pin fitting hole 16a1 and 16b1 -- with 16b--. Except for the width of face corresponding to the pars intermedia of the longitudinal direction, 64 bore 40a-- is drilled in four trains at fixed spacing, each stopper 20a and 20b-- contact right-and-left both sides in 32 bores, on the inferior surface of tongue of this tactile-sense pin guide plate 40, and they are these tactile-sense pins 20 and 20. -- Upper ** beyond the need is regulated.

[0032] In above-mentioned claim 1, an electromechanical coupling coefficient uses greatly each diaphragm 16a of a Uichi Hidari pair prepared in this tactile-sense section A with which is connected to this data-processing section C, and the fingertip ft of an index finger or the middle finger is equipped, and 16b-- as the piezo-electric single crystal component which has a very high piezoelectric constant.

[0033] In claim 2, it is the tactile-sense section A of the data-processing section C which made PZT ceramics this piezo-electric single crystal component.

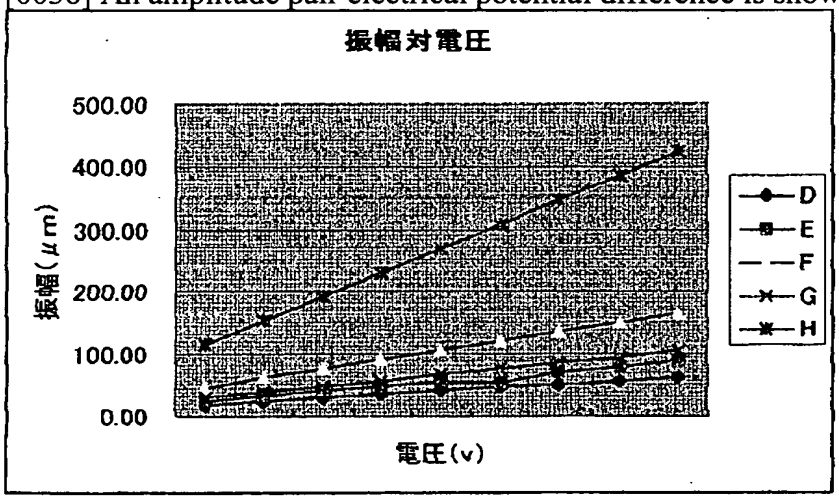
[0034] In claim 3, it is the tactile-sense section A of the data-processing section C which used this PZT ceramics as zinc niobic acid Pb(Zn1/3Nab 2/3) O3 (PZT) and the solid-solution single crystal PZNT 91/9 with PbTiO3(PT).

[0035] the driver voltage dependency (a car -- having) of the amplitude used as the bimorph element is shown below.

振幅の駆動電圧依存性(両持ち) 振幅(μm) 電圧(v)

| 電圧 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 |
|---|---|---|---|---|---|---|---|---|---|
| D | 17.20 | 22.94 | 28.67 | 34.41 | 40.14 | 45.88 | 51.61 | 57.34 | 63.08 |
| E | 24.00 | 32.00 | 40.00 | 48.00 | 56.00 | 64.00 | 72.00 | 80.00 | 88.00 |
| F | 45.51 | 60.68 | 75.75 | 91.02 | 106.19 | 121.36 | 136.53 | 151.70 | 166.87 |
| G | 28.80 | 38.40 | 48.00 | 57.60 | 67.20 | 76.80 | 86.40 | 96.00 | 105.60 |
| H | 115.20 | 153.60 | 192.00 | 230.40 | 268.80 | 307.20 | 345.60 | 384.00 | 422.40 |

[0036] An amplitude pair electrical potential difference is shown in the next table 2.

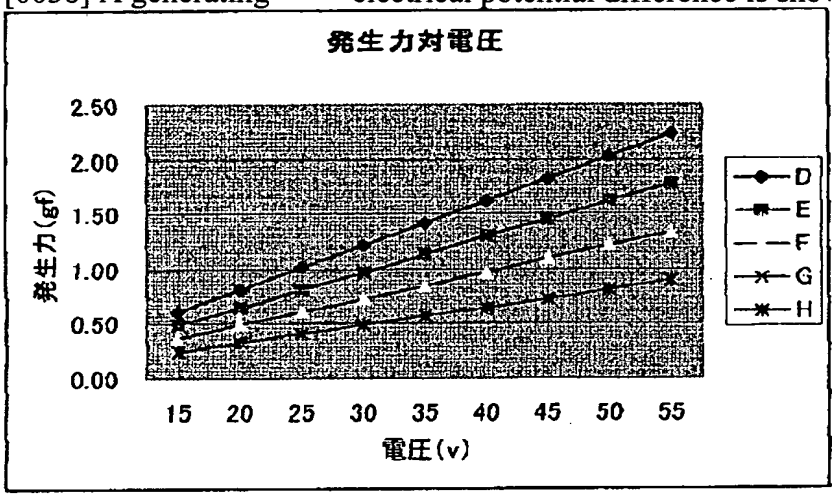



[0037] The driver voltage dependency of the generating force is shown in the next table 3.

発生力の駆動電圧依存性(両持ち)　　発生力(gf)　電圧(v)

| 電圧 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 |
|---|---|---|---|---|---|---|---|---|---|
| D | 0.61 | 0.81 | 1.01 | 1.22 | 1.42 | 1.62 | 1.82 | 2.03 | 2.23 |
| E | 0.49 | 0.65 | 0.81 | 0.97 | 1.13 | 1.3 | 1.46 | 1.62 | 1.78 |
| F | 0.36 | 0.49 | 0.61 | 0.73 | 0.85 | 0.97 | 1.09 | 1.22 | 1.34 |
| G | 0.49 | 0.65 | 0.81 | 0.97 | 1.13 | 1.3 | 1.45 | 1.62 | 1.78 |
| H | 0.24 | 0.32 | 0.41 | 0.49 | 0.57 | 0.65 | 0.73 | 0.81 | 0.89 |

[0038] A generating **** electrical potential difference is shown in the next table 4.




[0039] A fritillaria bulb full property design is the cantilever amplitude. It has delta=alpha xLf2/T2xV / 2 generating force F=beta xTxW/LfxV / two cars, and is delta'=1x4deltaF'=2F. It carries out.

[0040] The parameter of a uni-morph property design is shown in the next table 5.

ユニモルフ特性設計

片持ち
振幅　$\delta = \alpha \times L_f^2 / T^2 \times V / 2$
発生力　$F = \beta \times T \times W / L_f \times V / 2$

両持ち
$\delta' = 1/4\,\delta$
$F' = 2F$

| | | | 過去の試作時(T社) | | | 今回参考値 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | A | B | C | D | E | F | G | H |
| パラメータ | 厚み | PZT振動子(上) (mm) | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.10 | 0.10 | 0.05 |
| | | Sim材 t(mm) | 0.10 | 0.15 | 0.20 | 0.10 | 0.05 | 0.05 | 0.10 | 0.05 |
| | | ユニモルフ総厚み T(mm) | 0.25 | 0.30 | 0.35 | 0.25 | 0.20 | 0.15 | 0.20 | 0.10 |
| | 振動子 | 長さ L(mm) | 15.00 | 15.00 | 15.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 |
| | | 幅 W(mm) | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| | | 有効長 Lf(mm) | 12.50 | 12.50 | 12.50 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 |
| | 駆動電圧 | Vdo(v) | 75.00 | 75.00 | 75.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 |
| | 係数 | 振幅(経験値) $\alpha$ | 0.001024 | 0.001024 | 0.001024 | 0.001024 | 0.001024 | 0.001024 | 0.001024 | 0.001024 |
| | | 発生力(経験値) $\beta$ | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 |
| 理論値(計算値) | 振幅 | 片持ち ($\mu$m) | 134.40 | 100.00 | 76.97 | 137.63 | 192.00 | 364.09 | 230.40 | 921.60 |
| | | 両持ち ($\mu$m) | 33.60 | 25.00 | 19.24 | 34.41 | 48.00 | 91.02 | 57.60 | 230.40 |
| | 発生力 | 片持ち (gf) | 2.43 | 2.92 | 3.40 | 0.61 | 0.49 | 0.36 | 0.49 | 0.24 |
| | | 両持ち (gf) | 4.86 | 5.83 | 6.80 | 1.22 | 0.97 | 0.73 | 0.97 | 0.49 |
| 実測値 | 振幅 | 片持ち ($\mu$m) | 128.00 | 75.00 | 60.00 | | | | | |

[0041]

[Effect of the Invention] (1) Since the electromechanical coupling coefficient used very greatly diaphragm 16a prepared in the tactile-sense section A with which Fingertip ft is equipped, and 16b--

as the piezo-electric single crystal component (electrostrictive ceramics) which has a high piezoelectric constant according to the acoustic-sense auxiliary device concerning this invention, as compared with a well-known piezo-electric single crystal component, the big amount of displacement and the generating force are acquired by the low battery, and, as a result, the amplitude of 10 times or more is obtained.

[0042] (2) And change an input sound signal into an exact oscillating pattern with the big amplitude, and they are these diaphragms 16a and 16b. -- Each upper tactile-sense pin 20 and 20 -- are vibrated up and down independently of the bottom, respectively, the cutaneous sensation of the fingertip ft of a serious acoustic sense and aphasic is followed in exact oscillating pattern information, and transfer becomes possible.

[0043] (3) Therefore, miniaturize as compared with the well-known tactile-sense section, wearing to Fingertip ft becomes easy, and it becomes convenient to carry.

[0044] (4) Since the amplitude of 10 times or more is obtained as compared with an acoustic-sense auxiliary device with the well-known tactile-sense section of the acoustic-sense auxiliary device applied to this invention as above-mentioned, not conversion of the mere ingredient of the well-known tactile-sense section but a marked operation and effectiveness are acquired.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] It is the partial abbreviation perspective view showing the condition of the data-processing section of the acoustic-sense auxiliary device concerning this invention having been attached by the right wrist, and having equipped with that tactile-sense section at the tip of the index finger.
[Drawing 2] a part of tactile-sense section of drawing 1 -- it is fluoroscopy expansion flat-surface schematic drawing.
[Drawing 3] the condition that covering was able to be attached is shown from the tactile-sense section shown in drawing 2 -- it is fluoroscopy flat-surface schematic drawing a part.
[Drawing 4] It is cross-section schematic drawing by 1V-1V line part of the tactile-sense section of drawing 3 .
[Drawing 5] It is the expansion side-face schematic drawing which made the diaphragm of tactile-sense circles bimorph.
[Drawing 6] It is the expansion flat-surface schematic drawing of the bimorph diaphragm of drawing 5 .
[Drawing 7] It is the expansion side-face schematic drawing of the bimorph diaphragm of drawing 5 .
[Drawing 8] It is the expansion side-face schematic drawing which made the diaphragm of tactile-sense circles the uni-morph.
[Drawing 9] It is the expansion flat-surface schematic drawing of the uni-morph diaphragm of drawing 8 .
[Drawing 10] It is the expansion side-face schematic drawing of the uni-morph diaphragm of drawing 9 .
[Drawing 11] It is the partial enlarged section schematic drawing of the vibrator matrix in the tactile-sense section of the acoustic-sense auxiliary device by well-known acoustic-sense use.
[Description of Notations]
A -- Tactile-sense section;
B -- Flexible cable;
C -- Data-processing section;
ft -- ********** is the middle finger.;
10 -- Oblong casing;
10a, 10b -- Area;
10c -- Band for conclusion;
12 -- The 1st guidance bolt;
14 -- The 2nd guidance bolt;
16a, 16b -- Diaphragm;
18 -- Piezo-electric element;
20 -- Tactile-sense pin;
22 -- Insulating spacer.

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[Translation done.]

* NOTICES *



1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

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DRAWINGS

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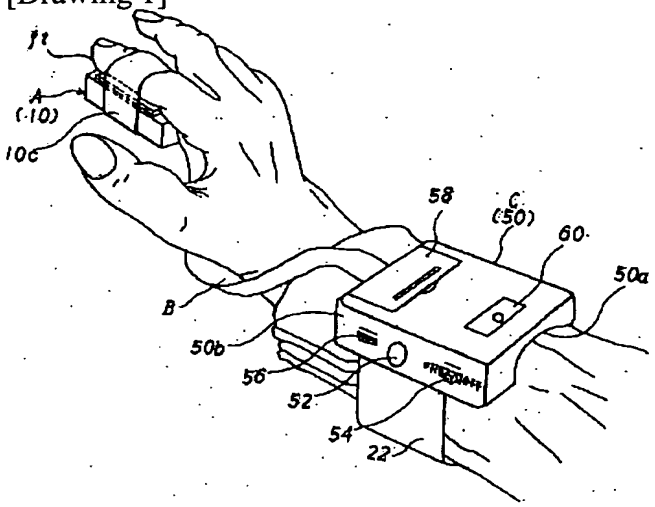
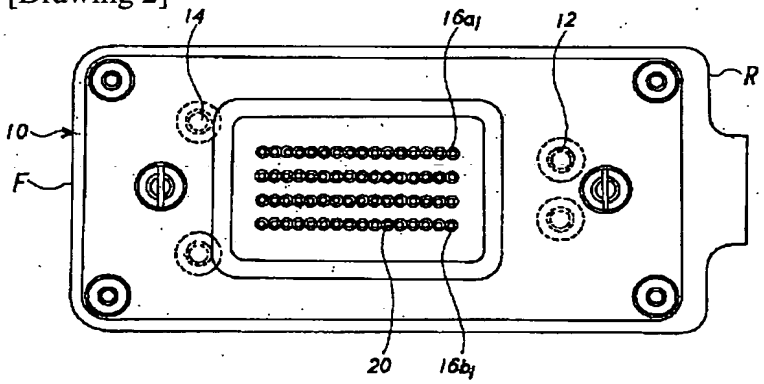
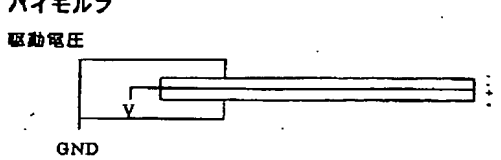
[Drawing 1]



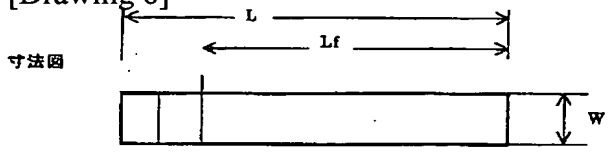

[Drawing 2]



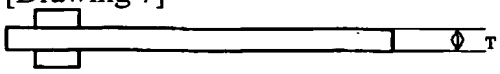

[Drawing 5]



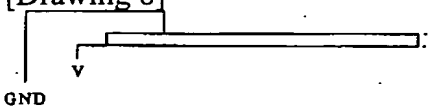

[Drawing 6]



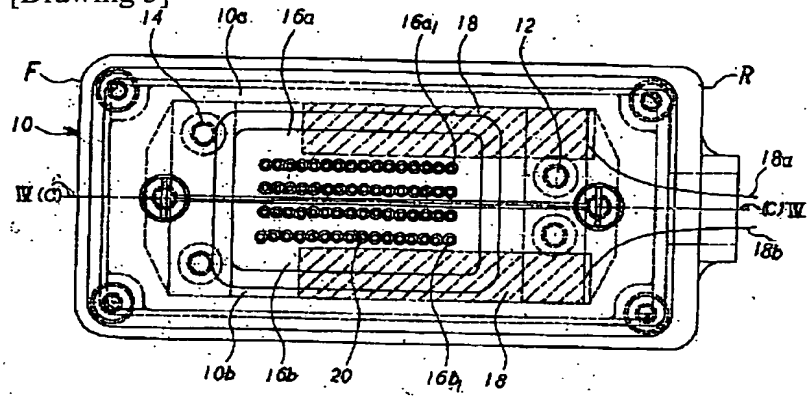
[Drawing 7]



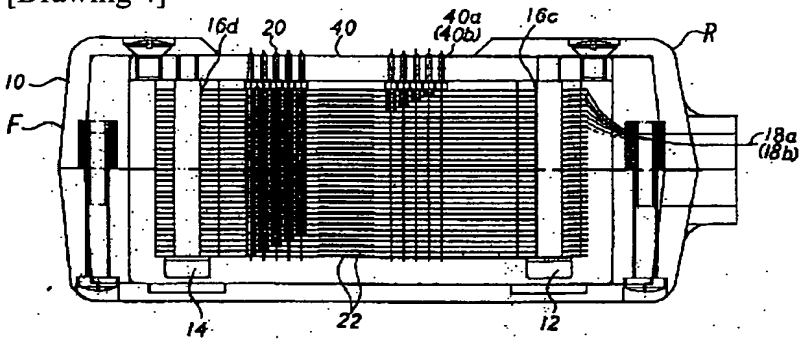

[Drawing 8]



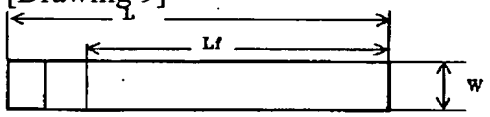

[Drawing 3]



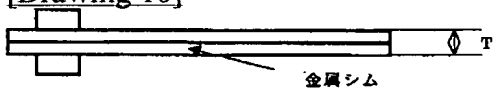

[Drawing 4]




[Drawing 9]

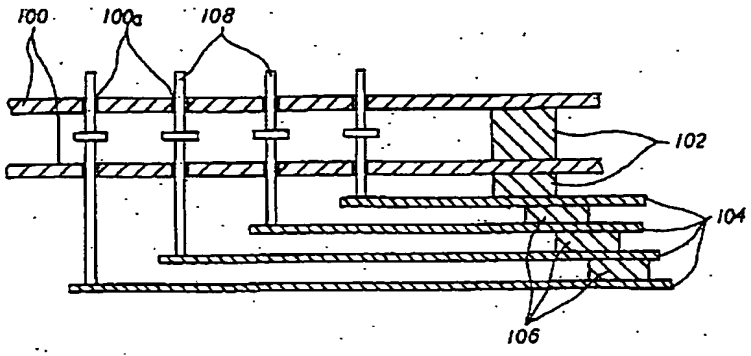



[Drawing 10]




L: 振動子長さ
Lf: 有効長
W: 幅
T: 総厚み

[Drawing 11]




[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（A）　(11)特許出願公開番号
特開2002－169462
（P2002－169462A）
(43)公開日　平成14年６月14日(2002.6.14)

| (51)Int.Cl.' | 識別記号 | FI | | テーマコード'(参考) |
|---|---|---|---|---|
| G09B 21/00 | | G09B 21/00 | B | 4G031 |
| C04B 35/46 | | C04B 35/46 | K | 5D004 |
| H01L 41/09 | | H04R 1/00 | 310G | 5D017 |
| 41/187 | | 17/00 | | |
| H04R 1/00 | 310 | H01L 41/08 | U | |

審査請求　未請求　請求項の数３　書面　（全 8 頁）　最終頁に続く

(21)出願番号　特願2000－403761(P2000－403761)
(22)出願日　平成12年12月２日(2000.12.2)

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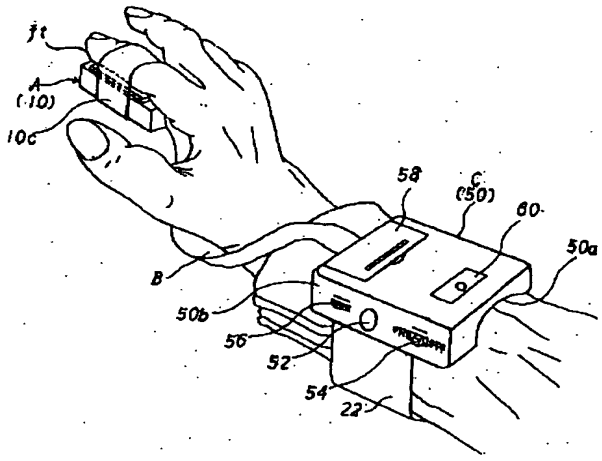
Ｆターム(参考)　4G031 AA11 AA14 AA26 AA32 BA10
5D004 AA03 BB01 CD01
5D017 AA11

(54)【発明の名称】　聴覚補助装置の触覚部の改良

(57)【要約】
【課題】公知の聴覚刺激装置の触覚部における最大の欠陥は、触覚刺激装置の触覚部を小型化するため、該触覚部内に設けられる振動板を可能な限り薄くするが、入力した音声情報を低電圧で電気信号に変換し、振動板に大きな変位量と力が得られないので、聴覚障害者の指先に確実な振動刺激として、音声情報を正確な振動パターン情報に変換して指先の皮膚に連続して伝達出来ない事である。
【解決する手段】聴覚・言語障害者の手首に取り付けられるデータ処理部に接続され、指先に装着される触覚部において、該触覚部内に設けられる振動板を圧電単結晶素子とし、圧電材料の中でこれまでにない最大の電気機械結合係数と、極めて高い圧電定数により、低電圧で大きな変位量と力を得、音声等の音響情報を周波数分解し、スウイープ呈示方式により該振動板上の角触覚ピンを下から独立して上下に振動させ、正確な振動パターン情報を、指先の皮膚に連続して伝達可能となる。



【特許請求の範囲】
【請求項１】重度の聴覚・言語障害者の手首に取り付けられるデータ処理部に接続され、且つ指先に装着される触覚部において；該触覚部内に設けられる振動板を電気機械結合係数が極めて大きく、且つ高い圧電定数を有する圧電単結晶素子として成り；入力音声信号を周波数分解し、スウイープ呈示方式により該振動板上の各触覚ピンを夫々下から独立して振動させ、正確な振動パターン情報に変換して指先の皮膚に連続して伝達することを特徴とする聴覚補助装置の触覚部の改良。
【請求項２】該圧電単結晶素子をＰＺＴセラミックスとして成る請求項１に記載にされた聴覚補助装置の触覚部の改良。
【請求項３】該ＰＺＴセラミックスを亜鉛ニオブ酸Ｐｂ（Ｚｎ１／３Ｎａｂ２／３）Ｏ３（ＰＺＴ）と、ＰｂＴｉＯ３（ＰＴ）との固溶体単結晶ＰＺＮＴ９１／９として成る請求項１及び２に記載された聴覚補助装置の触覚部の改良。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】この発明は、聴覚補助装置の触覚部の改良に関し、更に詳しくは、重度の聴覚・言語障害者のために、音声等の音響情報を周波数分解し、スウイープ呈示方式により触覚ピンを独立して上下に振動させ、正確な振動パターン情報を皮膚に連続して伝達する聴覚補助装置の触覚部に関し、平成１１年特許願第３７６８６８号及び特願２０００年第２５８１９７号の改良に関し、その触覚部内に設けられる振動板に電気機械結合係数が極めて大きく、且つ高い圧電定数を有する圧電単結晶素子（圧電セラミックス）を設け、低電圧で大きな変位量と力を得られ、且つ小型化が可能となる携帯に便利な聴覚補助装置の触覚部の改良に関する。
【０００２】
【従来の技術】重度の聴覚・言語障害者等に対し、ピエゾ効果により音声信号を振動パターンに変換し、振動ピンを介して指先に振動刺激を呈示する触覚刺激装置（例えば、特開昭６２－２７５２８４等）が提案されている。これらの触覚刺激装置においては、上下のピエゾ板間に導電板を挟んで一体化し、一端側から複数状の切り込みを形成し、複数本のピエゾ・バイモルフ・エレメントとし、ピエゾ板或いは導電板のいずれか一方を共通電極とし、他方をセグメント電極とし、回路基盤のピエゾ・バイモルフ・エレメントの先端部に所定長さの金属線を夫々固定した構造を採用している。
【０００３】更に図１１に示す通り、既に提案されている触覚刺激装置においては、２枚のガイド板１００の一端に絶縁性スペイサ１０２を介在させ、その下部に所要間隔で水平に整列された夫々長さが違う複数枚のピエゾ素子１０４の絶縁性スペイサ１０６を介在して所要間隔で水平に整列し、且つ該スペイサ１０４の一端に各下端が載せられた夫々の振動ピン１０８の上端を該ガイド板１００に穿設した透孔１００ａに下側から貫通させて指先の下面を刺激する振動子マトリックスとした触覚部である。
【０００４】
【発明が解決しようとする課題】公知の触覚刺激装置は、構成が必然的に大きくなって重量が増し、聴覚障害者が常時携帯するには極めて不便であり、各ピエゾ・バイモルフ・エレメントにより駆動される各振動ピンの本数が制限されるので、音声信号を正確な振動パターンに変換して指先に振動刺激として出力することは不十分であり、実験室レベルのもでしかなく、直ちに実用には向かないものであった。
【０００５】そして公知の触覚刺激装置の触覚部における最大の欠陥は、該触覚部を小型化し、低電圧で振動板に大きな変位量と力とを発生させられないことである。
【０００６】近年振動板に大きな変位量と力とを発生させるものとして圧電単結晶素子が注目され、医用超音波診断装置の送受信デバイスであるプローブ等に利用されている。
【０００７】その理由は、電気エネルギと超音波エネルギとの変換効率を表す電気機械結合係数（即ち、電気的総入力に対する機械的な形で結晶中に蓄積されたエネルギの比の平方根で定義したもの）が大きいことと、アレイプローブのように１素子が小さな場合に、送受信回路との電気的整合を図るためには誘電率が大きいほうが良いことである。このようなアレイプローブの例として、これまでジルコン・チタン酸鉛〔化学式｛Ｐｂ（Ｚｒ１－ｘＴｉｘ）Ｏ３、以下ＰＺＴ｝圧電セラミックスが利用されている。
【０００８】しかしＰＺＴ系圧電セラミックスの性能は、この２０年あまり改善されておらず、超音波プローブの性能向上は、多素子化や２次元アレイ化等の構造面からの改善によるところが大きい。
【０００９】最近超音波プローブの基本性能である感度と帯域の大幅な改善が期待される電気機械結合係数が極めて大きいリラクサ系圧電単結晶素子が提案されている。
【００１０】リラクサ（Ｒｅｌａｘｏｒ）は、誘電率の最大値を示す温度が周波数と共に高温度へ移動し、更に誘電率最大値が低下する性質（これを　Ｄｉｅｌｅｃｔｒｉｃ　ｒｅｌａｘａｔｉｏｎという）を示す強誘電体の総称である。
【００１１】リラクサが実用化されたものとしては、１９８２年にＪ．Ｋｕｗａｔａほかが報告した亜鉛ニオブ酸鉛Ｐｂ（Ｚｎ１／３Ｎｂ２／３）Ｏ３（ＰＺＮ）と、ＰｂＴｉＯ３（ＰＴ）との固溶体単結晶であるＰＺＮＴ９１／９がある。彼らは、この単結晶により初めて圧電特性の方位依存性を明らかにし、特に〔００１〕面の結晶は、その電気機械結合係数ｋ３３が９２％、圧電定数

ｄ３３＝１５００ｐＣ／Ｎと極めて高いことを報告している。

【００１２】ＰＺＴ圧電セラミックスは、１９５５年に初めて開発され、その後少量の添加物を加えることにより電気機械結合係数ｋ３３および圧電定数数ｄ３３が改良され、現在に至っている。ＰＺＴを単結晶にすれば、圧電特性が向上すると予想し、３０年以上前から研究されているが、未だに大型単結晶育成の成功例がない。これはジルコン酸鉛を含むと結合係数が大きな組成（＝菱面体晶育成と正方晶の相境界）では、分解しやすいためであり、２mm角を越える単結晶が得られていない。

【００１３】圧電単結晶ＰＺＮＴ９１／９は、これまでの圧電材料の中で最大の電気機械結合係数（ｋ３３＝９９%）を有することが判明した。この単結晶は、ＰＺＴに比較して構成元素が多いが、ジルコニウム（Ｚｒ）を含まないので、大型結晶が比較的容易である。

【００１４】最近ＰＺＮＴ系圧電単結晶は、フラックスと呼ばれる溶媒（この場合酸化鉛）に原料を入れて育成されている。育成法は、簡便性からは、フラックス法、組成制御や量産性からは、ブリッジマン法や引上げ法等が実施されている。

【００１５】これらブリッジマン法や引上げ法で、特に原料を入れた坩堝を冷却して４０mmφのウエファを切り出すことが可能な大きな結晶の育成が可能となった。この大きさの圧電単結晶素子を結合係数が最も大きい（００１）面に平行になるように切り出して大きな圧電特性を有するＰＺＮＴ９１／９単結晶ウエファを得た。

【００１６】ＰＺＮＴ以外のＰｂ（Ｍｇ１／３Ｎｂ２／３）Ｏ３－ＰｂＴｉ系でも優れた圧電特性を示すことがＳｈｒｏｕｔにより報告されている（T. Shroutet al, “Dielectric behavior of singlecrystals near（1－x）Pb（Mg1／3 Nb2／3）O3－（X）（PbTi O3 morphotropic phase boundary” Ferroelectric Letters, 12, pp, 63－69（１９９０）。

【００１７】これを表１において各種リラクサーチタン酸鉛系単結晶およびＰＺＴ系セラミックスの特性として示す。

表1 各種リラクサーチタン酸鉛系単結晶およびPZT系セラミックスの特性

| | PZNT91／9単結晶 | PZT系セラミックス |
|---|---|---|
| 電気機械結合係数 kt(%) | 60 | 45－55 |
| 電気機械結合係数k33(%) | 90－94 | 60－80 |
| 圧電定数d33(pC/N) | 1500－2500 | 200－800 |
| 融点(温度) | 1200前後 | 1350前後 |
| 単結晶サイズ | 40mm | ＜1mm |

【００１８】データ処理部の触覚部を小型化するために、該触覚部内に設けられる振動板を可能な限り薄くすることが考慮されるが、入力した音声情報を電気信号に変換し、聴覚障害者の指先に確実な振動刺激として伝達するためには、その厚みを余り薄く出来ないことである。

【００１９】

【課題を解決するための手段】この出願に係る発明は、前述のように重度の聴覚・言語障害者の手首に取り付けられるデータ処理部に接続され、指先に装着される触覚部において、該触覚部内に設けられる振動板を圧電単結晶素子であるＰＺＮＴ９１／９とし、圧電材料の中でこれまでにない最大の電気機械結合係数（ｋ３３＝９２%）と、極めて高い圧電定数（ｄ３３＝１５００ｐＣ／Ｎ）とを得ることにより、低電圧で大きな変位量と力を得、音声等の音響情報を周波数分解し、スウイープ呈示方式により該振動板上の角触覚ピンを下から独立して上下に振動させ、正確な振動パターン情報を、指先の皮膚感覚に連続して伝達する携帯に便利な聴覚補助装置の触覚部としたものである。

【００２０】この発明の第１の要旨は、音声等の音響情報を周波数分解し、スウイープ呈示方式により触覚ピンを独立して上下に振動させ、正確な振動パターン情報を、指先の皮膚に連続して伝達する携帯に便利な聴覚補助装置において、重度の聴覚・言語障害者の手首にデータ処理部を取り付け、該データ処理部に接続され、且つ指先に装着された触覚部内に設けられる振動板を電気機械結合係数が極めて大きく、且つ高い圧電定数を有する圧電単結晶素子を設け、低電圧で大きな変位量と力を得られ、且つ小型化が可能となる携帯に便利な聴覚補助装置において、低電圧で大きな変位量と力を得て入力音声信号を正確な振動パターンに変換して該振動板上の該各触覚ピンを夫々下から独立して上下に振動させ、正確な振動パターン情報を該皮膚に連続して伝達することを特徴とする聴覚補助装置の触覚部の改良である。

【００２１】この発明の第２の要旨は、電単結晶素子をＰＺＴセラミックスとして成る聴覚補助装置の触覚部の改良である。

【００２２】この発明の第３の要旨は、ＰＺＴセラミックスを亜鉛ニオブ酸Ｐｂ（Ｚｎ１／３Ｎｂ２／３）Ｏ３（ＰＺＴ）とＰｂＴｉＯ３（ＰＴ）との固溶体単結晶ＰＺＮＴ９１／９とし成る聴覚補助装置の触覚部の改良で

ある。

【００２３】

【発明の実施の態様】前述の通り、この発明の聴覚補助装置の触覚部において、重度の聴覚・言語障害者の手首にデータ処理部を取り付け、該データ処理部に接続され、且つ指先に装着される触覚部内に設けられる振動板を電気機械結合係数が極めて大きく、且つ高い圧電定数を有する圧電単結晶素子を設け、低電圧で大きな変位量と力を得られ、且つ小型化が可能となる携帯に便利な聴覚補助装置の触覚部であり、入力音声信号を正確な振動パターンに変換して該振動板上の該各触覚ピンを夫々下から独立して上下に振動させ、正確な振動パターン情報を該皮膚感覚に連続して伝達し、公知の圧電単結晶素子と比較して１０倍以上の振幅を有する振動板を設けた聴覚補助装置の触覚部の改良である。

【００２４】

【実施例】請求項１記載に記載された聴覚補助装置における触覚部の改良の実施例を図面について説明する。図１～１０において、この発明に係る聴覚補助装置の触覚部Ａは、人差し指又は中指の指先ｆｔ下面へ締結されるもので、手首上面に部分的に嵌合状態で取り付けられるデータ処理部Ｃを可撓性ケーブルＢで連結する。

【００２５】該触覚部Ａの側面に指先ｆｔへの締結用バンド１０ｃを取り付け、該人差し指また中指の指先ｆｔ下面に常時接触して設け、所要の大きさを有する横長ケーシング１０をその長手方向中心線ｃ、ｃで２分して形成される各区域１０ａ、１０ｂの後端Ｒ近くで中心線ｃ、ｃに接近して第１案内ボルト１２、１２を対称的に設け、前端Ｆ近くで外側近くに中心線ｃ、ｃに対して第２ボルト１４、１４を対称的に設けられる構成とする。

【００２６】該横長ケーシング１０の該各区画１０ａ、１０ｂ内に収納される左右一対の振動板１６ａ、１６ｂ‥は、その中心線ｃ、ｃで該第１案内ボルト１２、１２の内側からやや離れた箇所と、第２ボルト１４、１４の内側からやや離れた箇所まで所要間隔で２列に所要直径の触覚ピン嵌合孔１６ａ１、１６ｂ１‥を穿設し、該各振動板１６ａ、１６ｂ‥の上面で該触覚ピン嵌合孔１６ａ１、１６ｂ１‥の外側よりと、該各第１案内ボルト１２、１２よりに夫々ピエゾ素子１８、１８‥を設け、該各ピエゾ素子１８、１８‥にリード線１８ａ、１８ｂ‥の一端を夫々接続し、該リード線１８ａ、１８ｂ‥を所要の電線（図示せず）に接続する。

【００２７】該各振動板１６ａ、１６ｂ‥で該第１及び第２案内ボルト１２、１４の対応箇所に、該第２案内ボルト１２、１４の貫通孔１６ｃ、１６ｄを穿設し、該貫通孔１６ｃ、１６ｄに該第１及び第２案内ボルト１２、１４を貫通可能とする。

【００２８】前述の通り、左右一対の該各振動板１６ａ、１６ｂ‥を該区域１０ａ、１０ｂ内に夫々絶縁性スペイサ２２、２２‥を介して複数枚例えば３２枚を積層状態で配置し、該振動板１６ａ、１６ｂ‥の該触覚ピン嵌合孔１６ａ１、１６ｂ１‥内に夫々相違する長さを有する触覚ピン２０、２０‥を上下動自在に遊嵌し、積層状態の３２枚の該各振動板１６ａ、１６ｂ‥の該貫通孔１２ａ、１２ａ内に夫々該各第１案内ボルト１２、１４を嵌合する

【００２９】最上位の左右一対の該各振動板１６ａ、１６ｂに所要間隔を置いて該横長ケーシング１０の上部に一体に設けた触覚ピン・ガイド板４０にも、左右一対の各振動板１６ａ、１６ｂ‥の該触覚ピン嵌合孔１６ａ１、１６ｂ１‥の対応する箇所に触覚ピン嵌合孔４０ａ、４０ｂ‥を穿設する。

【００３０】そして該横長ケーシング１０の該各区画１０ａ、１０ｂ内に収納された左右一対の振動板１６ａ、１６ｂ‥の該触覚ピン嵌合孔１６ａ１、１６ｂ１‥内に、上端２０ｂ、２０ｂ‥を遊嵌し、人差し指又は中指の指先ｆｔ下面の皮膚に常時接触される。

【００３１】下部又は中間部に該各嵌合孔１６ａ１の直径よりやや大きいストッパ２０ａ、２０ｂ‥を一体に有し、下端が左右一対の３２枚の該各振動板１６ａ、１６ｂ‥と６４本の該触覚ピン２０，２０‥の各上端を該触覚ピン嵌合孔１６ａ１、１６ｂ１‥から接触する長さと幅と厚みとを有し、その長手方向の中間部に対応する幅を除き左右両側に３２個の透孔を４列に一定間隔で６４個の透孔４０ａ‥を穿設し、該各ストッパ２０ａ、２０ｂ‥が該触覚ピン・ガイド板４０の下面に接触して該触覚ピン２０、２０‥の必要以上の上動を規制する。

【００３２】前述の請求項１において、該データ処理部Ｃに接続され、且つ人差し指又は中指の指先ｆｔに装着される該触覚部Ａ内に設けられる左右一対の各振動板１６ａ、１６ｂ‥を電気機械結合係数が大きく、且つ極めて高い圧電定数を有する圧電単結晶素子とする。

【００３３】請求項２において、該圧電単結晶素子をＰＺＴセラミックスとしたデータ処理部Ｃの触覚部Ａである。

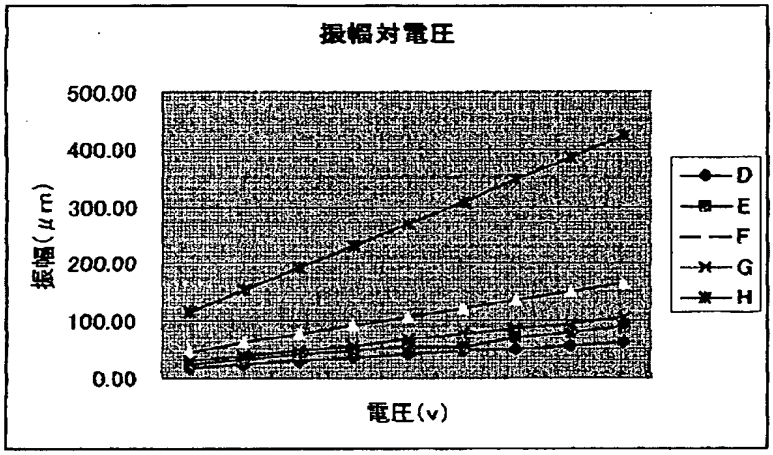
【００３４】請求項３において、該ＰＺＴセラミックスを亜鉛ニオブ酸Ｐｂ（Ｚｎ１／３Ｎａｂ２／３）Ｏ３（ＰＺＴ）と、ＰｂＴｉＯ３（ＰＴ）との固溶体単結晶ＰＺＮＴ９１／９としたデータ処理部Ｃの触覚部Ａである。

【００３５】バイモルフ・エレメントとした振幅の駆動電圧依存性（両持ち）を次に示す。

振幅の駆動電圧依存性(両持ち) 振幅(μm) 電圧(v)

| 電圧 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 |
|---|---|---|---|---|---|---|---|---|---|
| D | 17.20 | 22.94 | 28.67 | 34.41 | 40.14 | 45.88 | 51.61 | 57.34 | 63.08 |
| E | 24.00 | 32.00 | 40.00 | 48.00 | 56.00 | 54.00 | 72.00 | 80.00 | 88.00 |
| F | 45.51 | 60.68 | 75.75 | 91.02 | 106.19 | 121.36 | 136.53 | 151.70 | 166.87 |
| G | 28.80 | 38.40 | 48.00 | 57.60 | 67.20 | 76.80 | 86.40 | 96.00 | 105.60 |
| H | 115.20 | 153.60 | 192.00 | 230.40 | 268.80 | 307.20 | 345.60 | 384.00 | 422.40 |

【００３６】振幅対電圧を次の表２に示す。

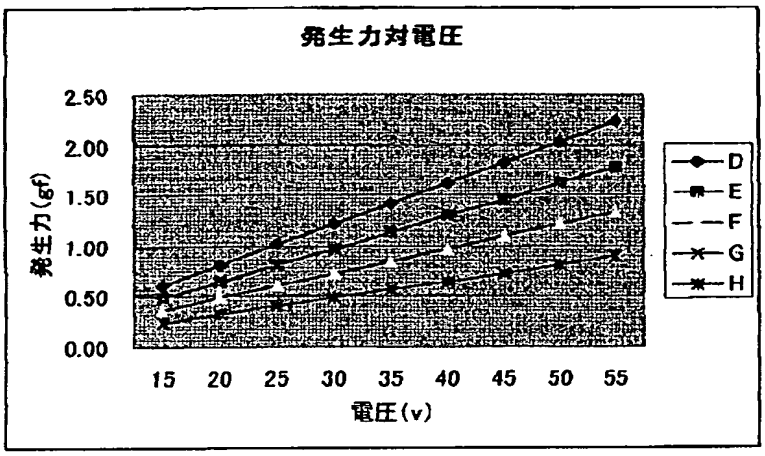



【００３７】発生力の駆動電圧依存性を次の表３に示す。

発生力の駆動電圧依存性(両持ち) 発生力(gf) 電圧(v)

| 電圧 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 |
|---|---|---|---|---|---|---|---|---|---|
| D | 0.61 | 0.81 | 1.01 | 1.22 | 1.42 | 1.62 | 1.82 | 2.03 | 2.23 |
| E | 0.49 | 0.65 | 0.81 | 0.97 | 1.13 | 1.3 | 1.46 | 1.62 | 1.78 |
| F | 0.36 | 0.49 | 0.61 | 0.73 | 0.85 | 0.97 | 1.09 | 1.22 | 1.34 |
| G | 0.49 | 0.65 | 0.81 | 0.97 | 1.13 | 1.3 | 1.45 | 1.62 | 1.78 |
| H | 0.24 | 0.32 | 0.41 | 0.49 | 0.57 | 0.65 | 0.73 | 0.81 | 0.89 |

【００３８】発生力対電圧を次の表４に示す。




【００３９】バイモフル特性設計は、
片持ち
振幅　$\delta = \alpha \times Lf^2 / T^2 \times V / 2$
発生力$F = \beta \times T \times W / Lf \times V / 2$
両持ち
ユニモルフ特性設計

片持ち
振幅　$\delta = \alpha \times LF / T^2 \times V / 2$
発生力　$F = \beta \times T \times W / Lf \times V / 2$

両持ち
$\delta' = 1 / 4\delta$
$F' = 2F$

$\delta' = 1 \times 4\delta$
$F' = 2F$　とする。

【００４０】ユニモルフ特性設計のパラメータを次の表５に示す。

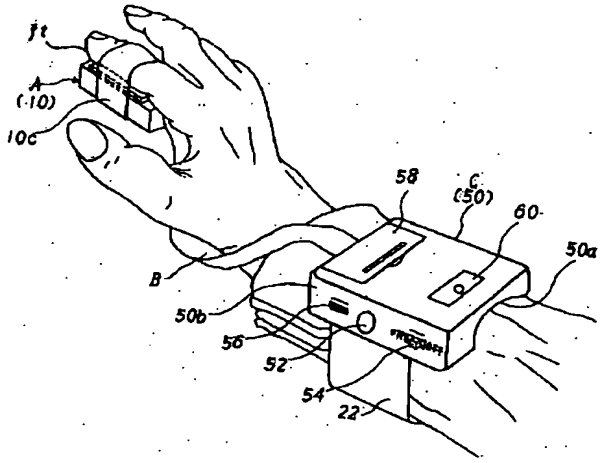
| | | | | 過去の試作時(T社) | | | 今回参考値 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | A | B | C | D | E | F | G | H |
| パラメータ | 厚み | PZT振動子(上) | (mm) | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.10 | 0.10 | 0.05 |
| | | Sim材 | t(mm) | 0.10 | 0.15 | 0.20 | 0.10 | 0.05 | 0.05 | 0.10 | 0.05 |
| | | ユニモルフ総厚み | T(mm) | 0.25 | 0.30 | 0.35 | 0.25 | 0.20 | 0.15 | 0.20 | 0.10 |
| | 振動子 | 長さ | L(mm) | 15.00 | 15.00 | 15.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 |
| | | 幅 | W(mm) | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| | | 有効長 | Lf(mm) | 12.50 | 12.50 | 12.50 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 |
| | 駆動電圧 | | Vdo(v) | 75.00 | 75.00 | 75.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 |
| | 係数 | 振幅(経験値) | $\alpha$ | 0.001024 | 0.001024 | 0.001024 | 0.001024 | 0.001024 | 0.001024 | 0.001024 | 0.001024 |
| | | 発生力(経験値) | $\beta$ | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 |
| 理論値(計算値) | 振幅 | 片持ち | ($\mu$m) | 134.40 | 100.00 | 76.97 | 137.63 | 192.00 | 364.09 | 230.40 | 921.60 |
| | | 両持ち | ($\mu$m) | 33.60 | 25.00 | 19.24 | 34.41 | 48.00 | 91.02 | 57.60 | 230.40 |
| | 発生力 | 片持ち | (gf) | 2.43 | 2.92 | 3.40 | 0.61 | 0.49 | 0.36 | 0.49 | 0.24 |
| | | 両持ち | (gf) | 4.86 | 5.83 | 6.80 | 1.22 | 0.97 | 0.73 | 0.97 | 0.49 |
| 実測値 | 振幅 | 片持ち | ($\mu$m) | 128.00 | 75.00 | 60.00 | | | | | |

【００４１】
【発明の効果】（１）この発明に係る聴覚補助装置によれば、指先ｆｔに装着される触覚部Ａ内に設けられる振動板１６ａ、１６ｂ‥を電気機械結合係数が極めて大きく、且つ高い圧電定数を有する圧電単結晶素子（圧電セラミックス）としたので、公知の圧電単結晶素子と比較して低電圧で大きな変位量と発生力が得られ、その結果１０倍以上の振幅が得られる。
【００４２】（２）そして大きな振幅により入力音声信号を正確な振動パターンに変換して該振動板１６ａ、１６ｂ‥上の各触覚ピン２０、２０‥を夫々下から独立して上下に振動させ、正確な振動パターン情報を重度の聴覚・言語障害者の指先ｆｔの皮膚感覚に連続して伝達可能となる。
【００４３】（３）従って、公知の触覚部と比較して小型化し、指先ｆｔへの装着が容易となり、携帯に便利となる。
【００４４】（４）前述の通り、この発明に係る聴覚補助装置の触覚部は、公知の聴覚補助装置に比較して１０倍以上の振幅が得られるから、公知の触覚部の単なる材料の変換ではなく、格段の作用、効果が得られる。
【図面の簡単な説明】
【図１】この発明に係る聴覚補助装置のデータ処理部を右手首に取り付けられ、その触覚部を人指し指の先端に装着した状態を示す部分略斜視図である。
【図２】図１の触覚部の一部透視拡大平面略図である。

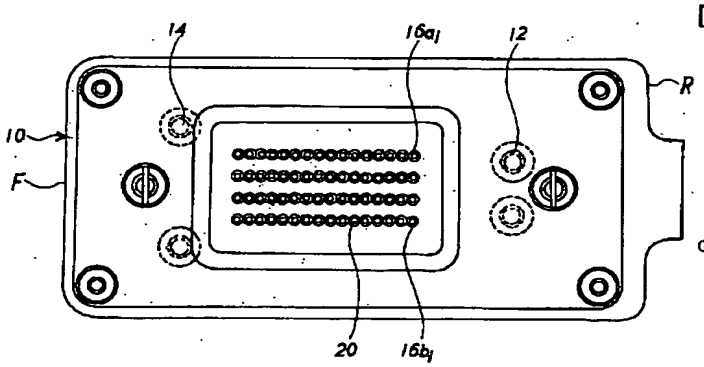
【図３】図２に示す触覚部からカバーを取り付けられた状態を示す一部透視平面略図である。
【図４】図３の触覚部の１Ｖ－１Ｖ線部分断面略図である。
【図５】触覚部内の振動板をバイモルフとした拡大側面略図である。
【図６】図５のバイモルフ振動板の拡大平面略図である。
【図７】図５のバイモルフ振動板の拡大側面略図である。
【図８】触覚部内の振動板をユニモルフとした拡大側面略図である。
【図９】図８のユニモルフ振動板の拡大平面略図である。
【図１０】図９のユニモルフ振動板の拡大側面略図である。
【図１１】公知の聴覚利用による聴覚補助装置の触覚部における振動子マトリックスの部分拡大断面略図である。

【符号の説明】
Ａ…触覚部；
Ｂ…可撓性ケーブル；
Ｃ…データ処理部；
ｆｔ…人差し指又は中指；
１０…横長ケーシング；
１０ａ、１０ｂ…区域；
１０ｃ…締結用バンド；
１２…第１案内ボルト；
１４…第２案内ボルト；
１６ａ、１６ｂ…振動板；
１８…ピエゾ素子；
２０…触覚ピン；
２２…絶縁性スペイサ。

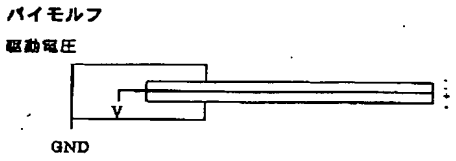
【図　１】



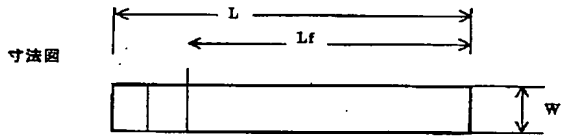

【図　２】



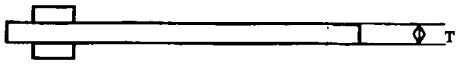

【図　５】



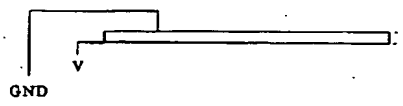

【図　６】




【図　７】




【図　８】



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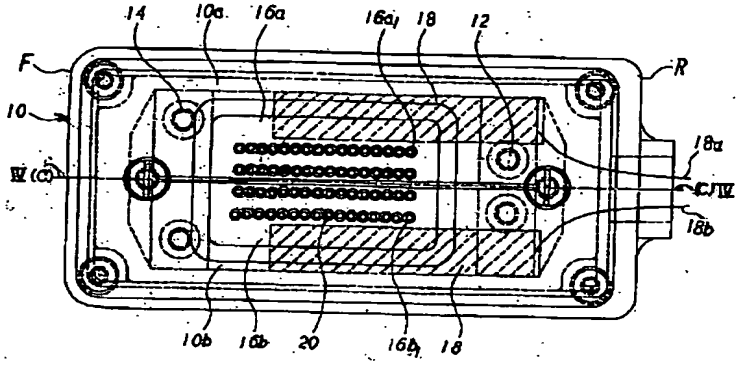


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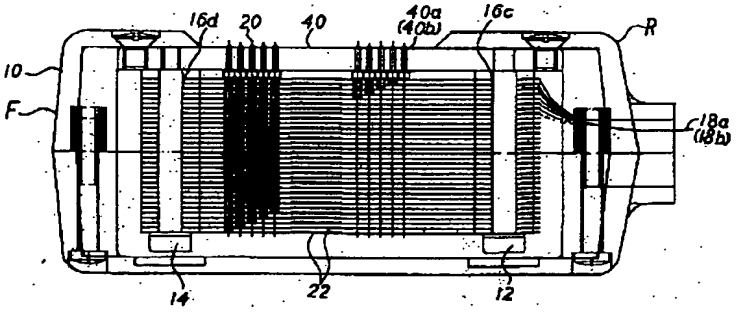


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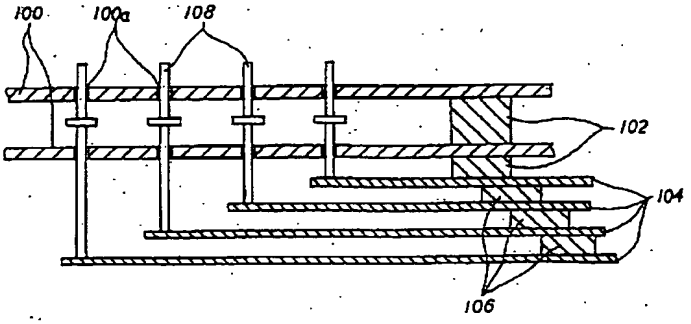


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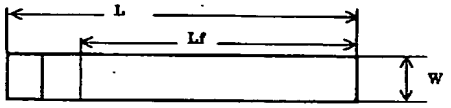


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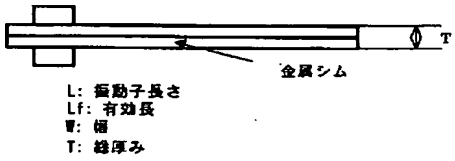


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| (51) Int. Cl.[7] | 識別記号 | F I | | テーマコード（参考） |
|---|---|---|---|---|
| H04R 17/00 | | H01L 41/08 | C | |
| | | | M | |
| | | 41/18 | 101D | |
| | | | 101F | |